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REMARKS

Claims 41-47 and 50-63 are pending. Claims 59-63 have been added and claims 48 and 49 have been canceled. Claims 41, 45, 46, 50, 53, 54 and 58 have been amended. Applicants respectfully request allowance of all pending claims.

Attached is a marked-up version of the changes being made by the current amendment.

Drawing Objections under 37 C.F.R. 1.83(a)

1. The office action objected to the drawings under 37 CFR 1.83(a) for not showing every feature of the invention specified in the claims.

Independent claim 54 has been amended to delete the recitation of "a means for adjusting a length of the complete gap." Applicants request withdrawal of the drawing objection under 37 C.F.R. 1.83(a).

Specification Informalities

2. The office action objected to the specification for clerical errors. These errors have been corrected herein by an amendment adopting the Examiner's recommended cosmetic changes to the specification.

Claim Objections

3. Claims 41, 45, 46, 50, 53 and 58 were objected to for clerical errors. These errors have been corrected herein by an amendment adopting the Examiner's recommended cosmetic changes to those claims.

4. Claims 48 and 49 were objected to in the office action as having insufficient antecedent basis for the limitation "the optical circulator." The objection is moot in view of the cancellation of claims 48 and 49.

Claim Rejections under 35 U.S.C. §112

5. Claims 41-45 and 54-58 were rejected under 35 U.S.C. §112, first paragraph. It was stated in the office action that the specification did not disclose any structure associated with the "adjusting means" recited in claims 54-58. As described above, claim 54 has been amended to remove the recitation of the "adjusting means."

Claims 41-45 are method claims and, therefore, it is not required to disclose a structure. One of ordinary skill in the art would know how to adjust the length of the complete gap between the first and second beam angle turners.

Applicants request withdrawal of the 35 U.S.C. §112, first paragraph rejections.

6. Claims 46-53 and 54-58 were rejected under 35 U.S.C. §112, second paragraph. It was stated in the office action that usage of the phrase "may be" in claims 46 and 50 renders those claims indefinite. Claims 46 and 50 have been amended to affirmatively claim nonreciprocal polarization rotators element. Amended claims 46 and 50 particularly point out and distinctly claim the subject which the Applicants regard as their invention.

Applicants request withdrawal of the 35 U.S.C. §112, second paragraph rejection of independent claims 46 and 54. Dependent claims 47-53 should be allowable for at least the same reasons.

Double-Patenting

7. Claims 46-49 and 50-53 were rejected under the judicially created doctrine of obviousness-type double-patenting. Applicants will submit a terminal disclaimer after determination of allowable subject matter.

Claim Rejections under 35 U.S.C. §102

8. Claims 41-58 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Pat. No. 5,982,539 to Shirasaki.

It is stated in the office action that Shirasaki discloses adjusting the complete gap causing a corresponding adjustment in spatial separation between a first light beam traveling from the first light port to the second optical port and a second light beam traveling from the second optical port to define the location of the for and third optical ports. It is further alleged that

Shirasaki discloses that it is inherent that the elements are "adjusted" during assembly in order to achieve alignment of the elements.

Applicants respectfully assert that the claimed adjustment of the complete gap is not inherent. "To serve as an anticipation when the reference is silent about the asserted inherent characteristic, such gap in the reference may be filled with recourse to extrinsic evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing being described in the reference, and that it would be so recognized by persons of ordinary skill." *Continental Can Co. v. Monsanto Co.* 948 F.2d 1264, 1268, 20 U.S.P.Q.2d 1746, 1749 (Fed. Cir. 1991) (emphasis added).

The office action directs Applicants' attention to Figs. 2, 7C, 7D, 8A and 8B. For the following reasons, the Applicants assert that these figures and the associated description do not discuss a complete gap or the adjustment of the length of such a gap as claimed in the present disclosure (claims 41 and 54 and at page 16 lines 3-14).

Fig. 2 illustrates the elements of the Shirasaki disclosure. The gap between the crystals is not illustrated or referenced. There is no suggestion that the gap between the birefringent wedges 108-1 and 108-2 is adjusted (col. 4 line 32-50). Further, there is no suggestion that Shirasaki recognizes that adjustment of a complete gap between the two circulator beams may be adjusted to determine the location of the optical ports.

Shirasaki Figs. 7C and 7D show examples of birefringent crystals that deflect a light beam either parallel or orthogonal, respectively, to a plane containing two parallel beams (col. 8 line 62 to col. 9 line 3). Figs. 8A and 8B are schematic diagrams showing other modifications to the birefringent wedge (col. 9 lines 55-58 and col. 10 lines 7-14). Neither the descriptions or the figures identify a complete gap or the adjustment of the gap.

The Examiner does not point to a location in Shirasaki where it is disclosed or suggested that adjusting a length of the complete gap causes a corresponding adjustment in a spatial separation between a first light beam traveling from the first optical port to the second optical port and a second light beam traveling from the second optical port to the third optical port, wherein in the location of the first light beam and the second light beam define the location of the first optical port and the third optical port. (Claim 41). There is no suggestion that Shirasaki discloses tuning of the complete gap as suggested in the office action. Hence, the elements

recited in claim 41 of the present application are not anticipated by Shiraski. Applicants request withdrawal of the 35 U.S.C. 102 rejection.

Dependent claims 42-45 and 54-58 should be allowable for at least the same reasons.

Claims 46 and 50 were rejected under 35 U.S.C. 102 as anticipated by Shirasaki. Claims 36 and 50 have been amended to recite that both the o-ray and the e-ray pass through both beam angle turners. Claim 46 and 50. Support for this amendment is found in the specification at page 17 lines 13-19. No new matter has been added.

In contrast, the Shirasaki reference discloses the o-ray and the e-ray pass through separate birefringent wedges. The light from fiber 104 is split into two beams and "they respectively enter the birefringent wedges 108-1 and 108-2." Col. 5 lines 13-22 and in FIG. 2.

Thus, Shirasaki does not disclose all the limitations recited in amended claims 46 and 50. Applicants respectfully request withdrawal of this 35 U.S.C. 102(a) rejection.

Applicant asks that all claims be allowed. Enclosed is a $212 check for excess claims and the petition for a one-month extension. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: 11/18/01

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Version with markings to show changes made

In the specification:

The paragraph beginning at page 17, line 13 is amended as follows:

Upon exiting the first nonreciprocal rotators, both components have the same polarization orientation before entering first beam angle turners 130A-B. First beam angle turners 130A-B turn both components towards the longitudinal axis of the circulator. The components then exit the first beam angle turner and transit complete gap 136. The components next pass through second beam angle turner 140A-B, which bends the components such that they are aligned with the longitudinal axis of second imaging element 172. Viewing from the top of the circulator (as-seen in FIG. [8A] 2A, discussed below), the longitudinal axis of the second imaging element should be on substantially the same line with the axis of the first imaging element to achieve circulation from second optical port 106 to third optical port 104. Complete gap 136 is adjusted such that the angle turning at second beam angle turners 140A-B occurs at the circulator axis that is in line with the axis of first imaging element 170 and second imaging element 172. The components then enter second nonreciprocal rotators 146A-B. In a preferable embodiment, second nonreciprocal rotator 146A rotates by 45 degrees clockwise a component of light passing through it from first optical port 102 to second optical port 106. In another preferable embodiment, second nonreciprocal rotator 146B rotates by 45 degrees counter-clockwise a component of light passing through it from first optical port 102 to second optical port 106. The component then pass through second beam displacer/combiner 150, where the beams are recombined. The recombined light beam then passes through second optical port 106 via second imaging element 172. Unpolarized light entering second optical port 106 will travel in the opposite direction. Second nonreciprocal rotators 146A-B will direct light along a different optical path towards third optical port 104. This creates optical circulation.

The paragraph beginning at page 33, line 26 is amended as follows

In this embodiment, the displacement (walk-off) distance d_3 of the light components is determined by the birefringence of the second beam angle turner 1040A and second beam angle turner 1040B. For example, in the case of a YVO_4 wedge pair, assuming the c axis of the YVO_4

is perpendicular to the longitudinal axis of the circulator, the displacement d_3 can be expressed as:

$$d_3 = \frac{1}{2}\ d_4\ Sin2\theta\left(\frac{n_c}{\sqrt{1-(n_c Sin\theta)^2}} - \frac{n_a}{\sqrt{1-(n_a Sin\theta)^2}}\right)$$

where θ is the wedge angle of the second beam angle turner 1040A-B angle, n_a and n_c are the index of refraction and polarization along the a axis and c axis respectively, and d_4 is the length of the complete gap 1036. An advantage of using the preferable birefringent wedge pair that may be formed by second beam angle turners 1040A-B is that the walk-off distance can be adjusted by simply changing the distance between the wedges of the wedge pair, as discussed above. Further, a large walk-off distance can be achieved cost effectively without using long birefringent walk-off crystals.

In the claims:

Claim 48 and 49 have been cancelled.

Claim 41, 45, 46, 50, 53, 54 and 58 have been amended as follows:

41. (Amended) A method of tuning a spatial separation between a first optical port of an optical circulator and a third optical port of the optical circulator comprising:

providing the optical circulator, and the optical circulator having a [longtudinal] longitudinal axis, and the optical circulator comprising a first optical port located at an end of the optical circulator, a second optical port located at a distal end of the optical circulator from the first optical port along the longitudinal axis, a third optical port located at the same end of the optical circulator as the first optical port, a first beam angle turner located along the longitudinal axis between the first optical port and the second optical port; and a second beam angle turner located along the longitudinal axis distally from the first beam angle turner, and the first beam angle turner and the second beam angle turner being separated by a complete gap; and

adjusting a length of the complete gap causing a corresponding adjustment in a spatial separation between a first light beam travelling from the first optical port to the second optical port and a second light beam travelling from the second optical port to the third optical port,

wherein the location of the first light beam and the second light beam define the location of the first optical port and the third optical port.

45. (Amended) The method of claim 41, wherein the optical circulator comprises [a] four or more optical ports.

46. (Amended) A method of transmitting an optical beam comprising:

passing the optical beam through a nonreciprocal optical device comprising a first compound beam angle turner and a second compound beam angle turner, wherein both an e-ray and an o-ray of the optical beam propagate through both the first beam angle turner and the second beam angle turner; and

wherein any polarization rotators of which the nonreciprocal optical device [may be] is comprised are nonreciprocal [polization] polarization rotators.

50. (Amended) An optical circulator comprising:

a nonreciprocal optical device comprising a first compound beam angle turner and a second compound beam angle turner, wherein both an e-ray and an o-ray of the optical beam propagate through both the first beam angle turner and the second beam angle turner; and

wherein any polarization rotators of which the nonreciprocal optical device [may be] is comprised are nonreciprocal [polization] polarization rotators.

53. (Amended) The optical circulator of claim 50, wherein the optical circulator comprises [a] four or more optical ports.

54. (Amended) An optical circulator, and the optical circulator having a [longtudinal] longitudinal axis, and the optical circulator comprising a first optical port located at an end of the optical circulator, a second optical port located at a distal end of the optical circulator from the first optical port along the longitudinal axis, the third optical port located at the same end of the optical circulator as the first optical port, and the optical circulator comprising:

a first beam angle turning means located along the longitudinal axis between the first optical port and the second optical port, for turning a beam through an angle;

a second beam angle turning means located along the longitudinal axis distally from the

first beam angle turner, for turning a beam through an angle, and the first beam angle turning means and the second beam angle turning means being separated by a complete gap; and

wherein [a means for] adjusting the length of the complete gap [for causing] causes a corresponding adjustment in a spatial separation between a first light beam travelling from the first optical port to the second optical port and a second light beam travelling from the second optical port to the third optical port, wherein the location of the first light beam and the second light beam define the location of the first optical port and the third optical port.

58. (Amended) The optical circulator of claim 54, wherein the optical circulator comprises [a] four or more optical ports.

Claims 59-63 have been added.